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OFFICE OF
PREVENTION, PESTICIDES
AND
TOXIC SUBSTANCES

Memorandum

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SUBJECT: Biological Benefits Assessment for Azinphos-methyl and Phosmet on Almonds

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Summary

Based on available published information and personal communication with crop experts, BEAD believes that extending the restricted entry intervals for phosmet and azinphos-methyl will have little impact on the important use of these chemicals at hull-split. It is expected that growers could adjust their cultural practices to meet the requirements of these extended intervals.

The early-season (May) use of phosmet or azinphos-methyl is not a common practice any longer; however growers with a high population of peach twig borer at this time may apply an insecticide to bring the levels down. Long (> several weeks) restricted entry intervals for the use of azinphos-methyl would practically remove it from the early

season use in almond orchards. There are effective alternatives for this use, though there are limitations with each.

Almond growers rely on azinphos-methyl and phosmet later in the season to control two important pests – the navel orangeworm and the peach twig borer. Both pests have the potential to cause significant economic damage to almonds, and have been linked to aflatoxin contamination in the product. Application of the insecticide occurs at hull split in July which takes place approximately four to six weeks prior to harvest. The activities which occur after hull split include harvest, poling of mummy nuts, and pruning. Almonds are not hand harvested. Poling to remove mummy nuts and pruning occurs in winter (November through January), and an extension of the REIs for these activities would be expected to have minimal impact as recommendations for mummy removal from the trees advise that this task should be completed by February.

Background

Nearly all the U.S. commercial production of almonds takes place in California, due to its unique climatic conditions. A rainy, mild winter followed by dry and warm weather in the spring and summer provide ideal conditions for almonds to flourish. However, because of California's climate, irrigation is usually necessary.

Almond trees must be planted in mixed cultivar orchards to allow bees to cross-pollinate, usually in February to early March. Thinning of the blossoms or fruit is not required as pollination naturally limits the set of nuts. Fruit begins to form in mid- to late March, and the nut matures in the July-August time frame. Harvest takes place in August through September and sometimes into early October, depending on the area and the cultivar.

Activities in the orchard take place mostly in the spring and summer, when irrigation, weed management, sampling for nutrient levels, and monitoring for pest and disease problems and for nut maturity are necessary. Applications of phosmet and azinphos-methyl are made at about hull split, in July. Worker activities after these applications include mowing, monitoring of almond maturity for scheduling harvest, orchard floor preparation, and scouting.   Preparation of the orchard floor for harvest activities includes discing and rolling to ensure a smooth surface for collecting the fallen nuts, ant control, and removal of debris. These activities require that workers re-enter the fields within two to four days after pesticide application.

Almonds are removed from the tree by mechanical shakers, and allowed to dry for seven to ten days on the clean orchard floor. The almonds are then swept into windrows by mechanical sweepers, the newest of which are similar in appearance to street sweepers and are self-contained, primarily for protection from the dust and heat. Older models are tractor-mounted with open cabs. Blowers are used to move almonds which have fallen at the base of the trees, and these too are swept into windrows and gathered with a mechanical harvester. Hand raking is done in almonds with less and less frequency as labor costs rise. Each orchard is harvested three times over a 4 to 8 week period as different varieties mature.

After harvest, worker activities include poling of the trees to remove mummy nuts (*see* information about alternative control for navel orangeworm), and later in the year, orchard management includes pruning, monitoring for weeds, and application of herbicides and insecticides.

***Production Data for Almonds*:**

<u>U.S. Almonds Production</u>

Commercial production of almonds in the United States is located in California. Total California almond production averaged 703 million pounds from 1997 to 1999, and was valued at $847 million according to the National Agricultural Statistics Service. See Table 1 for additional information.

Table 1. U.S. Almond Production: Area, Production, and Value, 1997 Through 1999 (averages)

U.S./State	Bearing Acreage	Production (million pounds)	Percent of U.S. Production	Value of Production ($1,000)
California	461,000	703	100%	$847,000

Source: USDA/NASS Agricultural Statistics 2000

Pest Biology for Azinphos-methyl and phosmet uses:

Both azinphos-methyl and phosmet are used to control the navel orangeworm and the peach twig borer which are considered major almond pests.

Navel Orangeworm, *Amyloid transitella*. The following is reported in the USDA Crop Profile for Almonds:

Navel orangeworm is the most important pest in almonds. It attacks most soft-shelled cultivars, or nuts with poor seal, feeding inside the nuts on the kernels. The resultant frass and deep channels from feeding render the nut unsalable. Some hard shell cultivars are more resistant to navel orangeworm attack. The navel orangeworm destroys kernels and it is associated with presence of aflatoxins.

Navel orangeworm larvae enter sound nuts after hull split and cause damage before harvest. Navel orangeworm overwinters as larvae inside mummy nuts left on the tree and in trash nuts left on the ground and in tree crotches. Adult moths emerge in spring and lay eggs on mummy nuts or nuts damaged by peach twig borer, which act as a food bridge for this generation of navel orangeworm. After hatching, navel orangeworm larvae of this first generation enter nuts damaged by the peach twig borer. This makes peach twig borer control very important. After hull split adults lay eggs directly on the hull of sound nuts and the tiny larvae enter nuts through the shell seal and do not emerge until they are adults. There are 3 to 4 generations of navel orangeworm per year.

Thirty percent damage to the nut crop is not uncommon in late harvested orchards. Growers are not paid for insect-damaged nuts and are charged sorting costs by processors to remove insect damaged nuts. Navel orangeworm damage is directly correlated to aflatoxin contamination of nuts. The U.S. almond industry is working to reduce their aflatoxin contamination rates because the European Union (EU) implemented stringent aflatoxin standards in 1999. More than 50% of the US almond crop is exported to Western Europe.

Monitoring: Egg traps are used to monitor navel orangeworm and provide proper timing for applying in-season insecticide applications.

Controls

Because of the potential for damage and loss from navel orangeworm, growers typically use several methods to control this pest, as described below.

Cultural Controls

Early harvest and excellent orchard sanitation are probably the most important components for navel orangeworm management in almonds. An early, rapid harvest reduces the opportunity for navel orangeworm larvae to gain access to nuts, reducing the potential for a population increase in the orchard. Because the navel orangeworm larvae overwinter in mummy nuts, the mummies must be removed and destroyed in a timely manner. Because peach twig borers and other lepidopteran damage predisposes nuts to navel orangeworm entry, these pests must be controlled to eliminate food sources for first generation navel orangeworm larvae and preclude an early season buildup of the navel orangeworm population in the orchard. Good sanitation - cleanup of extra nuts - is a must around hullers, bins, dryers, and buildings where nuts have been handled.

The 1987 California document, *Integrated Pest Management for Almonds*, states that "The most effective way to prevent economically destructive populations of navel orangeworm is to remove mummy nuts from the trees in February and destroy them. When a good orchard sanitation program is carried out in an orchard located at least 1/4 mile from infested trees, together with an early harvest, usually no sprays are needed for navel orangeworm damage."

Biological Controls

Two introduced wasps, *Goniozus legneri* and *Pentalitomastix plethoricus,* provide some control of navel orangeworm and are established in many areas but are not effective, by themselves, in controlling the pest.

Bacillus thuringiensis - Multiple sprays can control navel orangeworm, but they are not cost effective. In addition, in cool, wet springs, *Bt* activity against pests is diminished.

Pheromone confusion for navel orangeworm is being researched, but it may be very costly and the reliability of the application puffers needs additional research.

Chemical Control

Chemicals can be an important component for managing navel orangeworm in almonds and their use pre-harvest will provide 50-70 % reduction of the pest if used correctly. In general, grower concerns for moving away from organophosphates such as azinphos-methyl and phosmet include concern for mite outbreaks/predator and honeybee toxicity from use of pyrethroids in-season; secondary pest outbreaks from use of new, narrow-spectrum insecticides such as tebufenozide and spinosad; efficacy and residual control; and the development of resistance.

> Azinphos-methyl - 28 days PHI. Applied mid-season to 18.8% of the acres by ground at an average rate of 2 lb. a.i. per acre (1). Azinphos-methyl is the most effective material against navel orangeworm, peach twig borer, and defoliating lepidoptera when applied post-bloom. It is somewhat selective for predaceous mites but is highly toxic to parasitic wasps and generalist predators (5). This is the preferred material because of its longer residual, which makes it useful as navel orangeworm flights at hull split don't occur simultaneously and extends protection for the later harvested nuts. It is less disruptive to natural enemies.
>
> Esfenvalerate and Permethrin - (see peach twig borer). Use of these pyrethroids will reduce navel orangeworm levels if used during growing season, but mite outbreaks are likely, triggering the need for an application of a miticide.
>
> Carbaryl - 0 days PHI. Applied mid-season to 1% of the acreage by ground at an average rate of 3.2 lb. a.i. per acre (1). A useful material because it can be applied in an emergency situation up to 1 day prior to harvest. Effective on navel orangeworm, peach twig borer and other lepidopterous pests. It will also control San Jose scale crawlers and eriophyid mites. However, it is extremely disruptive to natural enemies and will generally cause mite outbreaks. It is toxic to honeybees (5).
>
> Phosmet - (see peach twig borer). Will also reduce navel orangeworm populations. Shorter residual compared to azinphos-methyl.
>
> Chlorpyrifos - Most use is for ants and peach twig borer. Can control navel orangeworm and is a viable alternative to azinphos-methyl.
>
> Diazinon - not registered in-season in California
>
> Malathion - Is not effective against navel orangeworm.

Spinosad - Limited experience with this narrow-spectrum insecticide suggests that the efficacy isn't high.

Peach Twig Borer, *Anarsia lineatella*. The following is reported in the USDA Crop Profile for Almonds.

The peach twig borer is a major pest in almonds, and other stone fruits; damaging almonds by feeding in rapidly growing shoots making it difficult to train young trees. Borers also feed directly on nutmeats causing them to be discarded and creating the greatest economic damage.

Probably of most importance, peach twig borer-damaged nuts contribute to navel orangeworm infestations. Peach twig borer infestations can be overshadowed by the more remarkable damage created by the frass and deep channeling in the nut meat by the navel orangeworm. As with the navel orangeworm, certain cultivars are more susceptible to peach twig borer.

The peach twig borer overwinters as first or second instar larvae in cells, primarily under the thin bark in limb crotches on first-to-third year wood. Overwintered larvae begin emerging at about bud break and feed on young leaves and buds. As terminals elongate, maturing larvae establish themselves in a single shoot or terminal and mine the interior of the shoot causing wilting and death.

Adults begin emerging in April. Moths of this generation generally oviposit on shoots but can infest developing fruit with the potential to cause significant nut loss when populations are heavy. Adults from this next generation emerge in late June or early July with most attacking fruit directly. Larvae feed in hulls or directly on the nutmeats, often causing serious crop loss. Peach twig borer larvae begin entering overwintering sites in August and continue throughout the fall. There are four or more generations each year.

Soft shell almonds are most susceptible to damage from peach twig borer. Before insecticides were available, the California Almond Growers Exchange recorded damage as high as 71%. In soft shell varieties, it is not uncommon to experience greater than 30% nut damage from the peach twig borer in untreated orchards.

Monitoring: Pheromone traps are widely used to monitor peach twig borer phenology and time in-season treatments. The most effective timing is 400 to 500 degree days after the beginning of the flight.

Controls

Biological Controls

Numerous natural enemies attack peach twig borer throughout the egg and larval stage. Natural enemies can cause significant mortality and as less disruptive insecticides are utilized, will probably play a more important role in regulating peach twig borer numbers. Among the most common are the wasps *Paralitomastix varicornis, Hyperteles lividus,* and the grain or itch mite, *Pyemotes ventricosus,* which feed on larvae in the hibernacula. The California gray ant has been found to be a significant predator of the peach twig borer in San Joaquin valley peach orchards.

The primary biological control of peach twig borer relies on the use of *Bacillus thuringiensis*. The program calls for *Bt* treatments at bloom and post-bloom to take advantage of the fact that peach twig borer does a considerable amount of feeding on leaves and stems before boring into new shoots.

Bacillus thuringiensis **-** 0 days PHI. Applied at least twice per season by ground or air to approximately 25% of the acreage at the average rate of 0.1 lb. a.i. per acre (1). It is selective for lepidoptera. Timing of applications is critical and *Bt* is often not effective when applied in cold, wet springs. Applied at bloom or post-bloom.

Mating disruption has been used for peach twig borer in more high value labor intensive crops such as peaches. Results have been variable and the cost of this program is currently too high for it to be widely adopted in almonds. This may change as better and cheaper formulations of pheromones are developed.

Chemical Controls

Traditionally, the peach twig borer was controlled with a dormant or delayed dormant application of one of the materials listed below. Current practices may include *Bt* at bloom or post-bloom, and in-season application of spinosad, organophosphates or pyrethroids at hull split.

Diazinon – Not labeled for in-season use. Applied to 18.5% of the acres, pre-bloom, at the average rate of 2 lb. a.i. per acre. It is extensively used for ground applications mixed with petroleum oil during the dormant period for control of peach twig borer, San Jose scale, European red and brown almond mite eggs, and fruit tree leafroller eggs. Peach twig borer and San Jose scale resistance has been documented in San Joaquin Valley peach orchards.

Azinphos-methyl – Most effective as an in-season material (see Navel orangeworm).

Esfenvalerate – 21 days PHI. This is a highly effective peach twig borer material when applied by ground during the dormant period. Used on 7% of the acreage by ground at 0.05 lb. a.i. per acre. It is also effective against other lepidopteran pests. This is the most economical material available. The biggest drawback is it disrupts biological control of mites, often even when applied during dormancy. Esfenvalerate will also control navel orangeworm; however, if used during the growing season this material is very disruptive to the biological control of mites and should only be used during the growing season in an emergency situation. Resistance has developed in some growing areas to esfenvalerate.

Phosmet – 30 days PHI. Effective on navel orangeworm, peach twig borer and other lepidoptera when used during growing season. Also used dormant for peach twig borer. It will control San Jose scale crawlers if crawlers are present. It is applied to 6% of the acres at an average rate of 3.0 lb. a.i. per acre. Phosmet can cause mite outbreaks but is not as disruptive as some other materials.

Carbaryl (see navel orangeworm) – Used late in season when other alternatives cannot be used because of longer PHIs. Disruptive; causes mite outbreaks.

Naled - 4 days PHI. Applied during the dormant period by ground to 1.5 % of the acreage at the rate of 1.5 lb. a.i. per acre. Provides fair control, however resistance develops quickly to naled.

Chlorpyrifos - 14 days PHI. Historically, this material is used as a dormant spray for control of the peach twig borer with over 50 % being used for ant control. For control of peach twig borer it is applied by ground during the dormant period to approximately 10% of the total acreage at an average rate of 1.5 lb. a.i. per acre. Cannot be used during the dormant period in the Sacramento Valley because damage to trees can result. Will also control lepidopteran pests when used post-bloom.

Methidathion - Primary use is for San Jose scale during dormancy. No in-season use.

Permethrin – 7 days PHI. Applied by ground during the dormant period to 10% of the acreage at an average rate of 0.2 lb. a.i. per acre. This is the most economical material available and has low mammalian toxicity. The biggest drawback is it tends to disrupt biological control of mites, even when applied during dormancy. Will also control navel orangeworm if used during the growing season but this material is very disruptive to the biological control of mites and should only be used during the growing season in an emergency situation.

Spinosad – Newly registered. Very effective against peach twig borer. Has been in short supply and is expensive; toxic to honeybees so limited to night application during bloom. No use data are available.

Emamectin benzoate - in pipeline, potential for dormant/in-season use.

Diflubenzuron - in pipeline

Tebufenozide - in pipeline

Economic Effects of Insect Damage:

Approximately 75% of domestic almond production is exported. As a result, the economic viability of the crop for growers is very dependent on criteria for product quality as demanded by the export markets. Following is a discussion of the concerns in the almond industry related to this issue, from Gene Beach, President of the Almond Hullers & Processors Association.

> "The recent change in the EU regulations is forcing U.S. growers to reevaluate the efforts made to prevent insect damage. Currently 2-10% of the product has some insect damage. To meet the EU criteria less than 2% insect damage is needed to have a 95% chance of meeting EU's aflatoxin standards (Schatzki 2001). The economic impact of aflatoxin contamination in the EU market is severe. If a shipped lot tests above the EU limits the costs may be destruction of the shipment or at a minimum the cost of returning the product to the U.S. and losing the sale. However, the almond industry need only look to the experience of the Iranian pistachio industry in Europe to see the economic impact of persistent aflatoxin contamination. Prior to 1997 the Iranians had 95% of the EU pistachio market. In 1997 the EU instituted a 3-month ban on importation of Iranian pistachios due to repeated high findings of aflatoxins. In response the amount of pistachios sold to the EU declined by 50% in 1998 and recovered to 80% in 1999 relative to the volume of pistachios imported in. The total value of the pistachios imported in 1998 declined by 60% and 32% in 1999 relative to the 1996 value. However, 3 years in a row of media reports warning consumers away from the consumption of pistachios in Germany has led to a sustained overall decline in consumption, furthermore Iran has lost market share to other pistachio producing countries. Given the importance of the EU market to the U.S. almond industry and given that Europe is the largest importer of almonds, it is critical that the U.S. industry become more vigilant in preventing aflatoxin contamination and sorting out potentially contaminated nuts. The key to prevention is preventing insect damage in the field and to a lesser extent during storage. Thus maintaining every effective tool against Navel orangeworm and Peach twig borer is critical to maintaining the export market of almonds."

Azinphos-methyl and Phosmet Usage in California

Azinphos-methyl

Table 2 lists the usage of azinphos-methyl on almonds in California. An average of 10% of California almond bearing acreage is treated with azinphos-methyl per year, and about 83,076 pounds of azinphos-methyl are applied. The average number of applications of azinphos-methyl per year in California is 1.05 with an application rate of 1 pound per acre per application. See Table 2 for additional information.

Table 2. Usage of Azinphos-methyl on Almonds in California.

U.S./State	Percent of Crop Treated	Base Acres Treated [1]	Total Pounds Applied (lbs)	Average Number of Applications (#/year)	Average Application Rate (lbs/acre)
California	10%	46,000	83,076	1.05	1.72

Source: Table data is a two year average of California Department of Pesticide Regulation estimates of azinphos-methyl usage from 1998 and 1999.

1. Base acres treated calculated using percent of crop treated estimates against bearing acreage from Table 1.

Note: The US EPA Quantitative Usage Analysis (QUA), 4/99, estimated an average of 21% of the almond crop treated and 160,000 pounds applied in the U.S.; based on ten years of data and multiple data sources.

Phosmet

Table 3 lists the usage of phosmet on almonds in California. An average of 7% of the California almond bearing acreage is treated with phosmet per year, and about 101,000 pounds of phosmet are applied. The average number of applications of phosmet per year in California is 1.12 with an application rate of 2.80 pounds per acre per application. See Table 3 for additional information.

Table 3. Usage of Phosmet on Almonds in California.

U.S./State	Percent of Crop Treated	Base Acres Treated [1]	Total Pounds Applied (lbs)	Average Number of Applications (#/year)	Average Application Rate (lbs/acre)
California	7%	32,200	101,000	1.12	2.80

Source: Table data is a two year average of California Department of Pesticide Regulation estimates of phosmet usage from 1998 and 1999.

1. Base acres treated calculated using percent of crop treated estimates against bearing acreage from Table 1.

Note: The US EPA Quantitative Usage Analysis (QUA), 6/99, estimates an average of 9% crop treated and 87,000 pounds applied in the U.S. Based on ten years of data and multiple data sources.

Usage of Azinphos-methyl and Phosmet by Target Pest

Azinphos-methyl The almond target pests for azinphos-methyl and phosmet are listed in Table 4. All azinphos-methyl usage on almonds is for the control of the navel orangeworm and the peach twig borer. About 65% of the azinphos-methyl applied to almonds is for the control of the navel orangeworm while the remaining 35% is applied to control the peach twig borer.

Phosmet The almond target pests for phosmet are the navel orangeworm, the peach twig borer, and the San Jose scale. Usage of phosmet on almonds is almost identical to usage of azinphos-methyl. Application for control of the navel orangeworm accounts for about 65% of total phosmet usage and application of phosmet for control of the peach twig borer accounts for about 35% of total phosmet usage. Application of phosmet for control of the San Jose scale accounts for a very small share of total phosmet usage on almonds. See Table 4.

Table 4. Target Pests for Azinphos-methyl and Phosmet [1]

Active Ingredient	Target Pest - Listed in Order Importance (Based on Estimated Usage by Pest [2])
Azinphos-methyl	Navel Orangeworm Peach Twig Borer

Active Ingredient	Target Pest - Listed in Order Importance (Based on Estimated Usage by Pest [2])
Phosmet	Navel Orangeworm Peach Twig Borer San Jose Scale

1. Sources: EPA proprietary data.
2. Importance based on the proportion of total azinphos-methyl or phosmet usage (total acre treatments) for the control of the pest.

As stated above, about 65% of both azinphos-methyl and phosmet, respectively, are applied to almonds to control the navel orangeworm. In this pest insecticide market combination azinphos-methyl holds about 15% of the total market and phosmet holds about 10% and the two insecticides rank third and fifth (in terms of total acre treatments), respectively, for this insecticide pest combination. From one to five, the most commonly used insecticides to control the navel orangeworm on almonds are chlorpyrifos, *Bacillus thuringiensis*, azinphos-methyl, permethrin, and phosmet (see Table 5).

Table 5 also lists the percent of the almond crop treated with each active ingredient. For example, according to the USDA's National Agricultural Statistics Service, 17% of the almond crop was treated with chlorpyrifos in 1999. Note that the percent of crop treated number covers all pests, and represents the percent of almond acres treated at least once, regardless of the target pest.

Table 5 does not, however, separate information that is key to understanding the importance of azinphos-methyl and phosmet at hull-split for the navel orangeworm. Because growers' best options for control of navel orangeworm includes several practices, from orchard sanitation to control of the pest at multiple points in the production cycle, one cannot interpret Table 5 to mean that azinphos methyl and phosmet are less important to the grower than other pesticides with more use. These are the insecticides of choice for control of this pest at hull-split.

Table 5. Leading Insecticides used for control of the Navel Orangeworm.

Pest	Insecticide - Listed in Order of Importance (Based on Estimated Usage by Pest [1])	Approximate Share of Total Insecticide Usage to Control the Navel Orangeworm[2]	% Crop Treated (All Pests)
Navel Orange-worm	1. Chlorpyrifos	25%	17%
	2. *Bacillus thuringiensis*	15%	18%
	3. Azinphos-Methyl	**15%**	**10%**
	4. Permethrin	15%	15%
	5. Phosmet	**10%**	**7%**
	6. Esfenvalerate	5%	14%
	7. Spinosad	5%	5%
	8. Propargite[3]	5%	22%
	9. Petroleum Oil	< 5%	58%
	10. Diazinon	< 5%	9%

Source: Target Pest Usage Data is based on EPA proprietary data.
1. Importance based on the proportion of total insecticide usage (total acre treatments) for the control of the navel orangeworm.
2. Source: Phosmet and azinphos-methyl estimates are from Table 2 and 3, respectively. All other estimates are from the USDA/NASS 1999 Fruit and Nut Summary, July 2000.
3. Propargite is a miticide, and is not effective against the navel orangeworm. Usage indicated here is likely related to the use of a pyrethroid to control the target insect, with propargite as follow-up to manage mite outbreaks.

As stated above, about 35% of both azinphos-methyl and phosmet, respectively, are applied to almonds to control the peach twig borer. In this pest insecticide market combination azinphos-methyl holds less than 5% of the total market while phosmet holds approximately 5%. In terms of total acre treatments, among all insecticides used to control the peach twig borer, phosmet ranks number 7 and azinphos-methyl ranks number 10.

Table 6 also lists the percent of the almond crop treated with each active ingredient. For example, according to the National Agricultural Statistics Service, 18% of the almond crop was treated with *Bacillus thuringiensis* in 1999. Note that the percent of crop treated number covers all pests, and represents the percent of almond acres treated at least once, regardless of the target pest.

Table 6 does not separate information that is key to understanding the importance of azinphos-methyl and phosmet at hull-split for the peach twig borer. Growers use many control methods to manage this pest, as for the navel orangeworm. For example, Table 6 suggests that *Bacillus thuringiensis* and esfenvalerate are among the leading insecticides used to control the twig borer. However, *Bacillus thuringiensis* is only used near bloom on smaller worms, taking advantage of their feeding on the shoots; and esfenvalerate is used in the dormant season, when mite outbreaks aren't facilitated by its toxicity to predators; leaving the window of control at hull-split for azinphos methyl and phosmet.

Table 6. Leading Insecticides used for control of the Peach Twig Borer.

Pest	Insecticide - Listed in Order of Importance (Based on Estimated Usage by Pest)[1]	Approximate Share of Total Insecticide Usage to Control the Peach Twig Borer	% Crop Treated (All Pests)[2]
Peach Twig Borer	1. *Bacillus thuringiensis*	30%	18%
	2. Chlorpyrifos	20%	17%
	3. Esfenvalerate	10%	14%
	4. Permethrin	10%	15%
	5. Petroleum Oil	10%	58%
	6. Diazinon	5%	9%
	7. Phosmet	**5%**	**7%**
	8. Spinosad	5%	5%
	9. Methidathion	< 5%	7%
	10. Azinphos-methyl	**< 5%**	**10%**

Source: Target Pest Usage Data is based on EPA proprietary data.
1. Importance based on the proportion of total insecticide usage (total acre treatments) for the control of the peach twig borer.
2. Source: Phosmet and azinphos-methyl estimates are from Table 2 and 3, respectively. All other estimates are from the USDA/NASS 1999 Fruit and Nut Summary, July 2000.

<u>Impacts associated with proposed mitigation</u>

***REI s for Phosmet and Azinphos-methyl*:**

Phosmet			Azinphos-methyl	
Current label REIs	Registrant proposed REI	PHI	Current label REIs	PHI
24 hours	27 days	14 days	14 days for hand harvesting; 2 or 3 days for all other activities	28 days

Almond growers rely on azinphos-methyl and phosmet to control the important pests navel orangeworm and peach twig borer. Both pests have the potential to cause significant economic damage to almonds, and have been linked to aflatoxin contamination in the product. Application of one of these insecticides occurs at about hull split, approximately four to six weeks prior to harvest. In some cases, an early spray in May to control peach twig borer is needed as well.

Worker activities in the orchard after the application of the pesticides in May include mowing, scouting for pests, irrigation, preparation of the orchard floor for harvest, and monitoring for nut maturity to plan harvest. Growers could accommodate an extended restricted entry interval for these activities after the early season use of phosmet, but a significant extension of the restricted entry interval would effectively cancel an early season use of azinphos-methyl. Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

Almonds are not hand harvested. Poling to remove mummy nuts occurs in winter (November through January), and an extension of the REIs for the application at hull split for this activity would be expected to have minimal impact as recommendations for mummy removal from the trees advise that this task should be completed by February. Pruning is also done late in the season, and extension of the REI for this task is not expected to conflict with the activity in the orchard.

Sources

Integrated Pest Management for Almonds, 1985. University of California, Statewide Integrated Pest Management Project. Division of Agriculture and Natural Resources. Pub. 3308.

USDA Crop Profile for Almonds in CA. Web address: http://pestdata.ncsu.edu/cropprofiles/docs/caalmonds.html

Update a Pest Management Evaluation for the Almond Industry. Chris Heintz, Almond Board of CA. March 31, 1999. Web address: http://lookercomm.com/almondPMA/Almond%20PME/1999pme.html

The Foundation for a Pest Management Strategic Plan in Almond Production. Almond Board of CA. June 12, 2000. Web Address: http://pestdata.ncsu.edu/pmsp/index.cfm